

Wind Cave Seed Study – Prairie restoration in a northern Great Plains national park

The Black Hills Community Inventory Report (Marriot et al. 1999) rated Wind Cave National Park exemplary for its large amounts of high quality habitat with natural processes in place. Thus, when Park activities disturb the ground and vegetation, re-establishing native vegetation as quickly as possible to preserve this integrity is a high priority. In the past, disturbed areas have been planted with a seed mix of commercially grown native grass species, but the Natural Resources staff has generally been disappointed with how this mix has performed. They saw the need to investigate the potential for a better mix of species. Also, because commercially grown seed lacks the diversity and genetic complexity of native plant communities, they wanted to test the feasibility of using seed collected from within the Park in future revegetation projects. As a result, the Wind Cave Seed Study began in 2004. This three-year research project is a cooperative effort between the U.S. Geological Survey and the National Park Service.

The art and science of rehabilitating natural vegetation in the northern Great Plains is generally not as well developed as it is for other parts of the US. Hence, when we began looking for information on species to plant, how to collect their seeds, what they look like when they're seedlings, etc., we realized that we could become a source, instead of sink, of this type of information for many species. We hope that this website provides you valuable information for your revegetation project.

For more information on this project, please click here (**[Link to Project Overview](#)**).

For information on seed collection, seed counts, and seedling identification, please go to the species list (**[Link to Species Table](#)**).

Project Overview

During the 2004 field season, the study team gathered baseline data on the success of the five-grass commercial seed mix and which species naturally colonized a disturbed area by establishing 100 permanent plots in the area disturbed by construction of a water pipeline. This area was planted with the standard grass mix, with a small portion being seeded in fall of 2000 and the remainder in spring 2001. These plots were paired with control plots located just off the waterline in undisturbed vegetation to determine the natural vegetation that could be expected for that soil type and site. Cover of all plant species, bare ground and litter were measured twice in all plots, once during the late spring and again during the late summer.

The second major task of 2004 was to collect and clean seed from 48 native species to be planted in test plots located in the “mixing circle”, a Park maintenance area where rubble and unused equipment had been stored. Rehabilitation of this area to natural vegetation was desired. For more information on the seed collection process and results see [link](#). Eight different seed mixes were planted in five replicate plots (plot size 9 m²), with one planting done in early December 2004 and another in mid-May 2005. The eight mixes incorporated three levels of “conservatism” (see <http://www.npwrc.usgs.gov/resource/plants/fqa/fqa.htm>), with two species mixes for each level, and two grass-only mixes (park collected vs. commercially grown). Control plots, in which nothing was planted, were also part of the experimental design.



Seed Study test plots, early May 2006.

In mid May 2005, we began to gather data on what was beginning to grow in the test plots. Data collection included mapping and counting seedlings of planted species, plus ocular cover estimates for both seeded and volunteer species. Through the process of collecting these data, we compiled a collection of photos and drawings of seedlings (often because we couldn't figure out what they were at first). These pictures, along with written descriptions of characteristics that we used to distinguish seedlings of a large number of species throughout the project (May 2005-September 2006) are available through the **Species Table (link)**.



Bison in the middle of study plots.



More "mixing circle" wildlife.

Some of the factors that make revegetation in the northern Great Plains and in national parks challenging include persistent drought and wildlife. Rainfall measured at the study plots during the 2005 growing season (May-September) was 33.6 cm (13.2 inches), which was a large improvement over the 2004 season when the seed was being collected. The drier 2004 season made plants unreliable about producing seed or caused them to set seed later than they normally would. The 2005 moisture tended to come in large amounts all at once with long periods in between of hot, dry, windy weather. During the dry periods, the plots were hand-watered in an effort to avoid desiccation of the seedlings. This effort added an additional 6.4 cm (2.5 inches) of water. 2006 growing season precipitation of 17.6 cm (6.9 inches) was well below the normal of 29.2 cm (11.5 inches), making life hard for new seedlings and those that had sprouted the previous year.

Wildlife species that affect seeded areas include deer, elk, bison, and rabbits. The bison are particularly troublesome because they not only eat the vegetation, but their footprints and wallows wipe out many seedlings. Browse use on shrub species in fall/winter of 2005 was moderate to heavy, particularly on prairie rose (*Rosa arkanansa*). The local rabbits in the plot area were so used to people that they will contentedly graze on the vegetation under the benches we use while collected data.

Annual reports and the final report from the project are available here **(Link)**.

Species Table. For information on seed collection and processing or seedling identification of a species, click on the symbol in the appropriate column. If there is no symbol, we do not have that information for that species. A description of our seed collection and processing effort, including definitions of terms used for individual species entries, can be found [here \(link\)](#).

Species	Common Name	Origin	Growth Form	Seed Collection and Processing	Seedling Identification
<i>Achillea millefolium</i>	common yarrow	native	forb	X	X
<i>Amaranthus blitoides</i> (<i>Amaranthus graecizans</i>)	prostrate pigweed	exotic	forb		X
<i>Ambrosia psilostachya</i>	Western ragweed	native	forb		X
<i>Amorpha canescens</i>	lead plant	native	shrub	X	X
<i>Andropogon gerardii</i>	big bluestem	native	grass	X	X
<i>Anemone cylindrica</i>	thimbleweed	native	forb	X	X
<i>Aristida purpurea</i>	red three-awn	native	grass	X	X
<i>Artemisia frigida</i>	fringed sagewort	native	subshrub	X	X
<i>Artemisia ludoviciana</i>	white sage; man sage	native	forb	X	X
<i>Asclepias speciosa</i>	showy milkweed	native	forb	X	X
<i>Bouteloua curtipendula</i>	sideoats grama	native	grass	X	X
<i>Bouteloua gracilis</i>	blue grama	native	grass	X	X
<i>Bouteloua hirsuta</i>	hairy grama	native	grass	X	X
<i>Brickellia eupatorioides</i> (<i>Kuhnia eupatorioides</i>)	false boneset	native	forb	X	X
<i>Calylophus serrulatus</i>	yellow evening primrose	native	forb	X	
<i>Chamaesyce glyptosperma</i> (<i>Euphorbia glyptosperma</i>)	ribseed sandmat	native	forb		X
<i>Chamaesyce stictospora</i> (<i>Euphorbia stictospora</i>)	slimseed sandmat	native	forb		X
<i>Chenopodium species</i>	common lambsquarters; arid land goosefoot	exotic	forb		X
<i>Cirsium undulatum</i>	wavyleaf thistle	native	forb	X	X
<i>Convolvulus arvensis</i>	field bindweed	exotic	forb		X
<i>Cynnoglossum officinale</i>	houndstongue	exotic	forb		X

<i>Dalea purpurea</i> (<i>Petalostemum purpureum</i>)	purple prairie clover	native	forb	X	
<i>Dichanthelium oligosanthes</i> (<i>Panicum oligosanthes</i>)	Scribner dichanthelium	native	grass		X
<i>Dyssodia papposa</i>	fetid marigold	native	forb	X	X
<i>Echinacea angustifolia</i>	purple coneflower	native	forb	X	X
<i>Elymus elymoides</i> (<i>Sitanion hystrix</i>)	squirreltail	native	grass	X	X
<i>Erysimum capitatum</i> (<i>Erysimum asperum</i>)	western wallflower	native	forb	X	X
<i>Euphorbia dentata</i>	toothed spurge	native	forb		X
<i>Glycyrrhiza lepidota</i>	wild licorice	native	forb	X	
<i>Grindelia squarrosa</i>	curlycup gumweed	native	forb	X	X
<i>Gutierrezia sarothrae</i>	snakeweed	native	shrub	X	X
<i>Helianthus annuus</i>	common sunflower	native	forb	X	X
<i>Hesperostipa comata</i> (<i>Stipa comata</i>)	needle-and-thread	native	grass	X	X
<i>Heterotheca villosa</i> (<i>Chrysopsis villosa</i>)	hairy false golden-aster	native	forb	X	X
<i>Ipomoea leptophylla</i>	bush morning-glory	native	forb	X	X
<i>Koeleria macrantha</i> (<i>Koeleria pyramidata</i>)	Junegrass	native	grass	X	X
<i>Leonurus cardiaca</i>	motherwort	exotic	forb		X
<i>Liatris punctata</i>	dotted blazing star; dotted gayfeather	native	forb	X	X
<i>Lithospermum incisum</i>	narrowleaf gromwell	native	forb	X	X
<i>Marrubium vulgare</i>	white horehound	exotic	forb		X
<i>Mirabilis linearis</i>	narrow leaf four o'clock	native	forb		X
<i>Monarda fistulosa</i>	wild bergamot, bee balm	native	forb	X	X
<i>Nassella viridula</i> (<i>Stipa viridula</i>)	green needlegrass	native	grass	X	X
<i>Oligoneuron rigidum</i> (<i>Solidago rigida</i>)	stiff goldenrod	native	forb	X	
<i>Onopordum acanthium</i>	scotch thistle	exotic	forb		X
<i>Onosmodium molle</i>	false gromwell	native	forb	X	X

<i>Opuntia macrorhiza</i>	Plains prickly pear	native	cactus			X
<i>Pascopyrum smithii</i> (<i>Agropyron smithii</i>)	western wheatgrass	native	grass	X		X
<i>Poa pratensis</i>	Kentucky bluegrass	exotic	grass			X
<i>Penstemon grandiflorus</i>	large beardtongue	native	forb	X		X
<i>Plantago patagonica</i>	woolly plantain; Indian wheat	native	forb	X		X
<i>Potentilla pensylvanica</i>	Pennsylvania cinquefoil; prairie cinquefoil	native	forb			X
<i>Psoraleidium tenuiflorum</i> (<i>Psoralea tenuiflora</i>)	slimflower scurfpea; wild alfalfa	native	forb	X		X
<i>Ratibida columnifera</i>	prairie coneflower	native	forb	X		X
<i>Rosa arkansana</i>	prairie wild rose	native	shrub	X		X
<i>Saliva reflexa</i>	lance leaf sage	native	forb			X
<i>Schedonnardus paniculatus</i>	tumblegrass	native	grass			X
<i>Schizachyrium scoparium</i> (<i>Andropogon scoparius</i>)	little bluestem	native	grass	X		X
<i>Sisymbrium altissimum</i>	tumble mustard; Jim Hill mustard	exotic	forb			X
<i>Solanum rostratum</i>	buffalobur	native	forb			X
<i>Solanum triflorum</i>	cutleaf nightshade	native	forb			X
<i>Solidago missouriensis</i>	prairie goldenrod	native	forb	X		
<i>Solidago nemoralis</i>	gray goldenrod	native	forb	X		
<i>Sphaeralcea coccinea</i>	scarlet globemallow	native	forb			X
<i>Sporobolus cryptandrus</i>	sand dropseed	native	grass	X		X
<i>Symphoricarpos occidentalis</i>	western snowberry; buckbrush	native	shrub	X		X
<i>Symphotrichum ericoides</i> (<i>Aster ericoides</i>)	heath aster	native	forb	X		X
<i>Trifolium repens</i>	white clover	exotic	forb			X
<i>Verbascum thapsus</i>	common mullien	exotic	forb			X
<i>Verbena bracteata</i>	prostrate vervain	native	forb	X		X
<i>Verbena stricta</i>	hoary vervain	native	forb	X		X

Wind Cave Seed Study-Seed Collection

The year that we collected seed for this study was unfortunately part of a prolonged drought. Collection was difficult because some species from which we wanted to collect seed didn't grow at all, were hard to find, or didn't produce seed. Another problem was heavy predation by insects and wildlife. These facts should be kept in mind when using the data below.

After we collected seed, we cleaned it to the point necessary for hand broadcast seeding. We then weighed the bulk amount of each species that we had. To translate this into *number* of seeds, we took five small subsamples from each species. For each subsample, we weighed the bulk amount, and then separated out the ripe, filled, undamaged seed. We counted these good seeds to give us an idea of the number of seeds per unit mass of material that we would hand broadcast in our experimental plots. For some species we also weighed these clean seeds for information on individual seed mass.

To access information on an individual species, go to the **species table (link)**.

Definitions/explanations of each of the terms used in the species seed collection information are below.

Average number of good seeds per gram bulk matter: Average number of seeds per gram of bulk matter, as measured in five subsamples. Number in parentheses following average is standard deviation.

Average number of good seeds per gram cleaned: Average number of seeds per gram of pure seed, separated from chaff, stems, leaves, etc., from five subsamples. Note that this is not necessarily PLS (pure live seed), as we do not have information on seed viability for many species. Number in parentheses following average is standard deviation.

Commercial estimates of seeds per gram: Values come from a variety of sources, including Natural Resource Conservation Service technical guides, commercial catalogs, and National Park Service native species propagation documents. Keep in mind that these values are for very clean seed compared to what we were measuring (e.g., awns from needle grasses removed).

Percent seed: pure seed mass/bulk seed mass X 100%, where pure seed mass is the weight (in grams) of the good seed, free of chaff, stems, etc. from a subsample, and bulk seed mass is the weight (in grams) of the seed matter cleaned to the state of planting by hand broadcast seeding (usually includes chaff, some small leaves, etc.)

Percent live: percent of seed that was viable, as measured by South Dakota State University Seed Laboratory

Collection dates: Dates that we collected seed at Wind Cave National Park, southwestern South Dakota, foothills of the Black Hills, in 2004. Many species matured late this year because of a late spurt of moisture after dry conditions early in the summer.

Collection effort: A very rough estimation of how much time it took to collect the given mass of bulk seed for a species. Estimates are rough because we often were collecting many species at the same time.

“n.m.” means not measured; “n.a.” means not available

***Achillea millefolium* – common yarrow**

Average number of good seeds per gram bulk matter: 419 (359)

Average number of good seeds per gram cleaned: n.m.

Commercial estimates of seeds per gram: 6174

Percent seed: 27

Percent live: n.m

Collection dates: August 26 & 29

Collection effort: 6 grams in 2 person-hours

Collection notes: It is impossible to collect this species without getting large amounts of chaff and litter. Seed collected in the park was poor due to some of it being underdeveloped, wormy or being covered with a black sooty residue.

Cleaning notes: To clean this seed and obtain a percent seed measurement, a microscope and dissecting tools were used. The bulk measurement included not only seed but also large amounts of chaff, but many of the empty seed heads had been removed.

***Amorpha canescens* – leadplant**

Average number of good seeds per gram bulk matter: 187 (81)

Average number of good seeds per gram cleaned: n.m.

Commercial estimates of seeds per gram: 355

Percent seed: n.m.

Percent live: 80

Collection dates: September 7 and 20

Collection effort: 105 grams in 2 person hours

Collection notes: Seed is easy to collect and can be fairly abundant. It often has bugs, so collect more than needed.

Cleaning notes: Bulk measurement was by counting hard seeds, those that weren't hard usually had bug exit holes

***Andropogon gerardii* – big bluestem**

Average number of good seeds per gram bulk matter: 22, 9, and 17, depending on collection site

Average number of good seeds per gram cleaned: n.m.

Commercial estimates of seeds per gram: 364

Percent seed: n.m.

Percent live: 59

Collection dates: September 7, 11, 12, 18

Collection effort: 578 g in 21 person-hours

Collection notes: Species is common in park, but flowering plants were rare in 2004 due to grazing and drought.

Cleaning notes: Bulk seed includes small pieces of stem, leaves, lemmas, glumes, etc.

***Anenome cylindrica* – candle anenome, thimbleweed**

Average number of good seeds per gram bulk matter: 981 (468)

Average number of good seeds per gram cleaned: n.m.

Commercial estimates of seeds per gram: n.a.

Percent seed: n.m.

Percent live: n.m.

Collection dates: August 25, 26 & 30

Collection effort: 8.2 grams in 2 person hours

Collection notes: Relatively easy to collect, once it is found. Not common or abundant.

Cleaning notes: Measurements of seed/gram bulk matter, included fluff and apparently empty seeds.

***Aristida purpurea* – red three awn**

Average number of good seeds per gram bulk matter: 238 (111)

Average number of good seeds per gram cleaned: 336 (150)

Commercial estimates of seeds per gram: 551

Percent seed: n.m.

Percent live: 89

Collection dates: September 23; October 6, 7, 11

Collection effort: 74 grams in 7 person hours

Collection notes: Plants are generally widely dispersed but quite visible when in fruit. The awns don't compact well, so it's difficult to collect and pack into bags.

Cleaning notes: Bulk matter consisted of awns, glumes and empty seed structures. Clean seed was only hard seed that included the lemma, awns and glumes. The seed broke easily while being checked for hardness, but generally hard seeds were dark and enclosed in light glume/lemma.

***Artemisia frigida* – fringed sagewort**

Average number of good seeds per gram bulk matter: 4117 (2143)

Average number of good seeds per gram cleaned: n.m.

Commercial estimates of seeds per gram: 8820

Percent seed: n.m.

Percent live: 72

Collection dates: November 8

Collection effort: 12.8 grams in 1 person hour

Collection notes: Abundant and easy to collect.

Cleaning notes: Prior to measuring "unclean" seed, the inflorescences were rubbed between the hands and what fell through a fine sieve was counted. However there still was lots of chaff mixed with the seed.

***Artemisia ludoviciana* – white sage, man sage**

Average number of good seeds per gram bulk matter: 3097 (1575)

Average number of good seeds per gram cleaned: n.m.

Commercial estimates of seeds per gram: 10593

Percent seed: n.m.

Percent live: n.m.

Collection dates: November 8 and 22

Collection effort: 9.1 grams in 1 person hour

Collection notes: Abundant and easy to collect.

Cleaning notes: Prior to measuring "unclean" seed, the inflorescences were rubbed between the hands and what fell through a fine sieve was counted. However there still was lots of chaff mixed with the seed.

***Asclepias speciosa* – showy milkweed**

Average number of good seeds per gram bulk matter: n.m.

Average number of good seeds per gram cleaned: 153 (64)

Commercial estimates of seeds per gram: n.a.

Percent seed: n.m.

Percent live: 72

Collection dates: September 16 and 20; October 7 and 11

Collection effort: 56 grams in one person hour

Collection notes: Seed disperse soon after maturation, so watch closely. Collecting when the pods are still slightly green is okay, as the seed inside is hard. Many pods had fungus or insect damage.

Cleaning notes: Cleaned seed had fluff removed and was hard seed only. One original count on uncleaned (in pod with some stem) weighed 359 g, and only 34.2 clean.

***Bouteloua curtipendula*- sideoats grama**

Average number of good seeds per gram bulk matter: 127 (62); 68 (41); 185 (104); depending on where sample was collected.

Average number of good seeds per gram cleaned: n.m.

Commercial estimates of seeds per gram: 421; 339 (169)

Percent seed: n.m.

Percent live: 41

Collection dates: September 29; October 12 and 18

Collection effort: 675 grams in 20 person hours

Collection notes: Many of the plants produced seed heads but very little seed itself, which was probably due to moisture stress. Although this species is very common in the park, flower stalks were only abundant in areas that burned within the last five years.

Cleaning notes: Bulk measurement was with stems, glumes, lemmas, leaves, etc.

***Bouteloua gracilis* – blue grama**

Average number of good seeds per gram bulk matter: n.m.

Average number of good seeds per gram cleaned: 191 (98)

Commercial estimates of seeds per gram: 1819; 1596 (772)

Percent seed: 18

Percent live: n.m.

Collection dates: October 11 and 20

Collection effort: 120 grams in 10 person hours

Collection notes: Abundant and most plants flowered but again many seed heads were empty.

Cleaning notes: Cleaned seed was with empty florets but stripped from rachis.

***Bouteloua hirsuta* – hairy grama**

Average number of good seeds per gram bulk matter: n.m.

Average number of good seeds per gram cleaned: 313 (163)

Commercial estimates of seeds per gram: 1510

Percent seed: 23

Percent live: 42

Collection dates: October 11 and 20

Collection effort: 50 grams in 10 person hours

Collection notes: Look for in areas with lots of bare soil. It appeared to produce more seed in an area that was burned in 2001 or 2002.

Cleaning notes: Cleaned seed was stripped from rachis but included empty florets.

***Brickellia eupatorioides* – false boneset**

Average number of good seeds per gram bulk matter: 132 (60)

Average number of good seeds per gram cleaned: n.m.

Commercial estimates of seeds per gram: 1044

Percent seed: n.m.

Percent live: 25

Collection dates: August 25; October 7 and 11

Collection effort: 41 grams in 5 person hours

Collection notes: Abundant and easy to collect.

Cleaning notes: Bulk matter measurement was as it comes off the plant often with a few involucre.

***Calylophus serrulatus* – yellow evening primrose**

Average number of good seeds per gram bulk matter: n.m.

Average number of good seeds per gram cleaned: 872 (514)

Commercial estimates of seeds per gram: n.a.

Percent seed: n.m.

Percent live: n.m.

Collection dates: September 8 and 9.

Collection effort: 2 grams in 2 person hours

Collection notes: Difficult to collect because the widely scattered populations are hard to find. After maturing the pods burst open and most of the seeds fall quickly. Manually removing the seed from the pods is quite time consuming, the pods are tough and stringy and part of the seed is persistent to them.

Cleaning notes: Clean seed was out of the pods but with lots of chaff. The fingernail test seems to destroy good seed.

***Cirsium undulatum* – wavyleaf thistle**

Average number of good seeds per gram bulk matter: n.m.

Average number of good seeds per gram cleaned: 109 (46)

Commercial estimates of seeds per gram: n.a.

Percent seed: n.m.

Percent live: 67

Collection dates: July 20; August 16; October 6 and 20

Collection effort: 40 grams in 5 person hours

Collection notes: Relatively common and easy to collect however it tends to have a lot of insect damage.

Cleaning notes: Most appeared to be pure seed however a few might have been buggy or empty.

***Dalea purpurea* – purple prairie clover**

Average number of good seeds per gram bulk matter: 22 (10)

Average number of good seeds per gram cleaned: n.m.

Commercial estimates of seeds per gram: 639

Percent seed: 95-100

Percent live: n.m

Collection dates: August 25, 26 and 30

Collection effort: 23 grams in 6 person hours

Collection notes: Easy to collect once plants are found, but collect more than expected because of insect damage. Also beware of confusing this species with *Dalea candida* because they often grow together.

Cleaning notes: Bulk measurement included calyx and bad seed.

***Dyssodia papposa* – fetid marigold**

Average number of good seeds per gram bulk matter: 469

Average number of good seeds per gram cleaned: 1878

Commercial estimates of seeds per gram: n.a.

Percent seed: 25

Percent live: n.m.

Collection dates: November 8, 22

Collection effort: 20 g in 2 person-hours

Collection notes: This species should be collected earlier than when it was for this project, as most of the seed was gone by this time.

Cleaning notes: Bulk seed had most stems removed but included many involucre and bracts. Clean seed was good seed with attached pappus (fluff). To get seed from picked state to bulk (planting) state, simply rubbed the inflorescences between hands to dislodge seeds from involucre.

***Echinacea angustifolia* – purple coneflower**

Average number of good seeds per gram bulk matter: 55

Average number of good seeds per gram cleaned: 346

Commercial estimates of seeds per gram: 254

Percent seed: 66

Percent live: n.m.

Collection dates: August 23, 25 and 30; September 1, 2, and 23

Collection effort: 107 grams in 4 person hours

Collection notes: Abundant, obvious and easy to collect

Cleaning notes: Cleaning it isn't easy, because seed is fairly persistent to the seed head which has sharp points on it.

Bulk seed measurement was off stalks but with a lot of bracts. Clean seed was hard seed only.

***Elymus elymoides* – squirreltail bottlebrush**

Average number of good seeds per gram bulk matter: 124

Average number of good seeds per gram cleaned: 160

Commercial estimates of seeds per gram: 187

Percent seed: 41

Percent live: 91

Collection dates: July 15; August 2, 3, and 19

Collection effort: 76 grams in 21 person hours

Collection notes: Relatively common but somewhat difficult to collect because awns make it difficult to put collected seed in a bag.

Cleaning notes: Bulk matter measurement includes lemmas, glumes, awns, and unfilled seed. Cleaned seed had the lemmas glumes and awns but contained only hard seed. Removing the seed from the rachis is quite time consuming so it would be more economical spread the seed using the entire seed head.

***Erysimum asperum* – western wallflower**

Average number of good seeds per gram bulk matter: n.m.

Average number of good seeds per gram cleaned: 3005

Commercial estimates of seeds per gram: n.a.

Percent seed: n.m.

Percent live: n.m.

Collection dates: July 14 and 15

Collection effort: >6 grams in 4 person hours

Collection notes: Easy to collect large amounts from a few plants if found at the correct time, but seed dispersed soon after maturation. Watch carefully!

Cleaning notes: Cleaned seed measurement included seed only. All seed broke when tested with fingernail so counted all but the empty looking ones.

***Gaura mollis* – scarlet gaura**

Average number of good seeds per gram bulk matter: n.m.

Average number of good seeds per gram cleaned: 67

Commercial estimates of seeds per gram: n.a.

Percent seed: n.m.

Percent live: n.m.

Collection dates: August 30 and September 24

Collection effort: 12 grams in 4 person hours

Collection notes: Hard to find after the flowers are gone. We could not find enough to use in our study.

Cleaning notes: Clean seed measurement included seed only, all seeds were hard and a few shriveled ones were rejected.

***Glycyrrhiza lepidota* – wild licorice**

Average number of good seeds per gram bulk matter: 40 (19)

Average number of good seeds per gram cleaned: n.m.

Commercial estimates of seeds per gram: n.m.

Percent seed: 26

Percent live: n.m.

Collection dates: September 7

Collection effort: >7 grams in 4 person hours

Collection notes: Easy to collect in large amounts, but hard to clean. Much of it had insect damage so we didn't plant it.

Cleaning notes: Average ratio of bad to good seeds =2.5 (bad usually because of insects). Each pod has 2 to 4 seeds and the pods are very difficult to open. Each has to be done individually.

***Grindelia squarrosa* – curlycup gumweed**

Average number of good seeds per gram bulk matter: 420; 314 (depending on where collected)

Average number of good seeds per gram cleaned: 600

Commercial estimates of seeds per gram: n.a.

Percent seed: n.a.

Percent live: n.m.

Collection dates: October 20 and 21

Collection effort: 57 grams in 3 person hours

Collection notes: Easy to collect in large amounts. Rubbing alcohol is useful for cleaning sticky sap off of clippers and fingers.

Cleaning notes: Seed in bulk measurement was only scraped out of the involucre while the clean seed measurement was hard seeds only.

***Gutierrezia sarothrae* – broom snakeweed**

Average number of good seeds per gram bulk matter: 245

Average number of good seeds per gram cleaned: 3135

Commercial estimates of seeds per gram: 3527

Percent seed: n.m.

Percent live: n.m.

Collection dates: November 8 and 22

Collection effort: 49 grams in 2 person hours

Collection notes: Easy to collect in large amounts.

Cleaning notes: Bulk measurement included flower heads and some stalks all crushed up. Cleaned seed was hard seeds with a small amount of fluff.

***Helianthus annuus* – common sunflower**

Average number of good seeds per gram bulk matter: 74

Average number of good seeds per gram cleaned: 1667

Commercial estimates of seeds per gram: n.a.

Percent seed: n.m.

Percent live: 62

Collection dates: September 9 and 15

Collection effort: 29 grams in 6 person hours.

Collection notes: Easy to collect if large amounts can be found. Seed tend to be damaged by insects so collect more than you think you will need.

Cleaning notes: Bulk seed measurement was off the involucre but with lots of bracts. Cleaned seed was hard seeds only.

***Hesperostipa comata* – needle and thread**

Average number of good seeds per gram bulk matter: n.m.

Average number of good seeds per gram cleaned: 39

Commercial estimates of seeds per gram: 254

Percent seed: n.m.

Percent live: 71

Collection dates: July 8 and 9.

Collection effort: 110 grams in 24 person hours.

Collection notes: Seeds disperse soon after maturing, so watch carefully. Large sized seed and long awns make collection slow and seed hard to pack into collection bags. Plan on collecting a lot more seed than you think you'll need.

Cleaning notes: Cleaned seed measurement was mostly pure seed and awns. A few seeds were soft (therefore not counted) but most were hard.

***Heterothica villosa* – hairy false golden aster**

Average number of good seeds per gram bulk matter: 516

Average number of good seeds per gram cleaned: n.m.

Commercial estimates of seeds per gram: 1764

Percent seed: n.m.

Percent live: n.m.

Collection dates: August 31

Collection effort: 4.4 grams in 6 person hours

Collection notes: Easy to collect and abundant.

Cleaning notes: Bulk measurement seed was off the stalks but had lots of bracts in it.

***Ipomoea leptophylla* – bush morningglory**

Average number of good seeds per gram bulk matter: n.m.

Average number of good seeds per gram cleaned: 9.2

Commercial estimates of seeds per gram: n.a.

Percent seed: 40

Percent live: 67

Collection dates: September 20 and 28

Collection effort: 363 grams in 13 person hours

Collection notes: Species is fairly rare in the park and many of the seeds we found and collected were insect damaged. We ended up collecting from private land south of Hot Springs and found a lot of seed with holes in it and small white grubs.

Cleaning notes: Clean seed measurement had seed out of the pods and most of the buggy or moldy seed removed.

***Koeleria macrantha* – prairie junegrass**

Average number of good seeds per gram bulk matter: n.m.

Average number of good seeds per gram cleaned: n.m.

Commercial estimates of seeds per gram: 7361

Percent seed: 20.8

Percent live: n.m.

Collection dates: July 13, 14 and 21

Collection effort: n.a.

Collection notes: Even though this species is fairly common in the Park we had a lot of problems collecting and cleaning it. Seed was collected from many different areas in the Park. The few references we could find told us that our collection date for this species was timely, however most of the seed was very soft and much of it was covered with a black sooty looking material. Plus, many samples had tiny flies on them that could only be seen with the aid of a microscope. After spending quite a bit of time collecting, cleaning and doing seed counts we ended up not planting it, because we feared it wouldn't be viable.

Cleaning notes: n.a.

***Liatris punctata* – dotted gayfeather**

Average number of good seeds per gram bulk matter: 96

Average number of good seeds per gram cleaned: 188

Commercial estimates of seeds per gram: 300

Percent seed: 37

Percent live: 58

Collection dates: September 7, 20, 22, 23, 25 and 28

Collection effort: 54 grams in 10 person hours

Collection notes: Easy to collect.

Cleaning notes: Bulk measurement was off the stalks but had lots of bracts and fluff. Clean measurement was hard seed only.

***Lithospermum incisum* – narrowleaf gromwell**

Average number of good seeds per gram bulk matter: n.m.

Average number of good seeds per gram cleaned: 188

Commercial estimates of seeds per gram: n.a.

Percent seed: n.m.

Percent live: n.m.

Collection dates: July 26, 27, and 29; August 9 and 16.

Collection effort: 1.5 grams in 5 person hours

Collection notes: Collecting this species is time consuming. We also didn't find or collect enough at the proper time to use in the study. Seeds on this plant mature at different times and drop shortly after they mature. Also, it appears to be a favorite of ants, many of the plants that had mature seed were also covered with ants.

Cleaning notes: Clean seed measurement was basically pure seed but a few still had the calyx attached.

***Monarda fistulosa* – bee balm, horse mint**

Average number of good seeds per gram bulk matter: n.m.

Average number of good seeds per gram cleaned: 3279

Commercial estimates of seeds per gram: 3302

Percent seed: 11

Percent live: n.m.

Collection dates: September 1 and 2

Collection effort: 2 grams in 2 person hours

Collection notes: Abundant and easy to collect.

Cleaning notes: The clean seed measurement was pure seed as far as we could tell, although there may have been a few that were empty or insect damaged. Fingernail test seemed to destroy good seed.

***Nasella viridula* – green needlegrass**

Average number of good seeds per gram bulk matter: n.m.

Average number of good seeds per gram cleaned: 226

Commercial estimates of seeds per gram: 370, 365

Percent seed: 85

Percent live: 95

Collection dates: July 7 and 9

Collection effort: 216 grams per 14 person hours

Collection notes: Seed is dispersed soon after it matures, so watch closely when it begins to ripen. The seeds on each rachis mature at different times. It works well to pull a closed hand (instead of using a fingernail) gently along the rachis to dislodge only mature (dark colored) seed and leave immature seed (green or light colored) behind.

Cleaning notes: Clean seed measurement was with awns attached and a few stalks but was mostly pure seed.

***Oligoneuron rigidum* – stiff goldenrod**

Average number of good seeds per gram bulk matter: 627

Average number of good seeds per gram cleaned: n.m.

Commercial estimates of seeds per gram: 1632

Percent seed: 57.6

Percent live: n.m.

Collection dates: September 25

Collection effort: 67 grams in 1 person hour

Collection notes: Easy to collect large amounts in short amount of time

Cleaning notes: Bulk measurement was as it comes off the plant, often with involucre and bracts.

***Onosmodium molle* – false gromwell**

Average number of good seeds per gram bulk matter: n.m.

Average number of good seeds per gram cleaned: 52

Commercial estimates of seeds per gram: n.a.

Percent seed: n.m.

Percent live: 99

Collection dates: July 26 and 28; August 2 and 3; September 25; October 6, 7, 11, 12 and 20; November 8.

Collection effort: 133 grams in 15 person hours

Collection notes: Difficult to collect a lot at one time because plants are scattered, plus seeds are slick and fall from the plant easily (not necessarily into the hand or a collection bag). Also, the seed from one plant doesn't ripen all at once, but instead over a long period of time.

Cleaning notes: Clean measurement was pure seed with a few empty hulls.

***Pascopyrum smithii* – western wheatgrass**

Average number of good seeds per gram bulk matter: 15

Average number of good seeds per gram cleaned: 275

Commercial estimates of seeds per gram: 243; 300

Percent seed: 9.5

Percent live: n.m.

Collection dates: September 26; October 7 and 25

Collection effort: 370 gram in 14 person hours

Collection notes: Even though this species is a dominant grass in the park, in 2004 when we were trying to collect seed for the project we found no plants producing seed and very few even flowering. It was assumed this was because of drought. The seed used in the project was collected on private and Forest Service lands south of Custer SD. Plants there that produced seed were generally in shaded areas or at the bases of rock outcrops where moisture may have accumulated.

Cleaning notes: Bulk measurement included stems, leaves, lemmas, glumes, etc. Clean seed measurement was hard seed with a small amount of lemma and glume.

***Penstemon grandiflorus* – large beardtongue**

Average number of good seeds per gram bulk matter: n.m.

Average number of good seeds per gram cleaned: 591

Commercial estimates of seeds per gram: 1212

Percent seed: 43

Percent live: 97

Collection dates: July 28; August 15 and 23

Collection effort: 21 grams in 8 person hours

Collection notes: Not a common plant and browsers often eat flower stalks. Also some of the seed collected was fungus damaged.

Cleaning notes: Clean seed measurement was pure hard seed.

***Plantago patagonica* – woolly plantain**

Average number of good seeds per gram bulk matter: n.m.

Average number of good seeds per gram cleaned: 1392

Commercial estimates of seeds per gram: n.a.

Percent seed: n.m.

Percent live: n.m.

Collection dates: July 12 and 13; August 18

Collection effort: 2.8 grams in 4 person hours

Collection notes: Not common but each plant produces a lot of seed.

Cleaning notes: Clean seed measurement was basically pure seed but a few with calyx still attached.

***Psoraleidum tenuiflorum* – slimflower scurfpea**

Average number of good seeds per gram bulk matter: 39

Average number of good seeds per gram cleaned: n.m.

Commercial estimates of seeds per gram: n.a.

Percent seed: 81

Percent live: 95

Collection dates: August 31; September 1, 9, 22, 25 and 27.

Collection effort: 289 grams in 26 person hours.

Collection notes: Even though this plant is abundant in the park, it's somewhat difficult to collect because not all seeds ripen at once on each plant. The seeds are fairly large and have to be picked one at a time off of the open and airy plants. The seed is widely dispersed on the branches. Most plants don't produce much seed. Also, we later found that a lot of the seed had been gutted by insects (this wasn't obvious when it was picked)

Cleaning notes: Bulk measurement was done in the pods with a few stems, leaves and gutted seeds.

***Ratibida columnifera* – prairie coneflower**

Average number of good seeds per gram bulk matter: 893

Average number of good seeds per gram cleaned: 1910

Commercial estimates of seeds per gram: 1625

Percent seed: 59

Percent live: 58

Collection dates: August 16, 19, 23, and 30.

Collection effort: 52 grams in 3 person hours

Collection notes: Easy to collect however you'll get a lot of litter and other flower parts with the seed. Size of the seed was highly variable.

Cleaning notes: Bulk measurement was off the stalks with calyx but no leaves. Clean seed was hard seed with the calyx still attached.

***Rosa arkansana* – prairie wild rose**

Average number of good seeds per gram bulk matter: n.m.

Average number of good seeds per gram cleaned: 69

Commercial estimates of seeds per gram: 88

Percent seed: n.m.

Percent live: 64

Collection dates: September 20

Collection effort: 39 grams in 4 person hours

Collection notes: Relatively easy to collect. Each rose hip holds a lot of seed.

Cleaning notes: Clean seed measurement was after wet fruits (soaked over night) were mashed to separate pulp from seed, air dried, then winnowed or dried pulp picked out.

***Schizachyrium scoparium* – little bluestem**

Average number of good seeds per gram bulk matter: 144; 30; 106;

Average number of good seeds per gram cleaned: n.m.

Commercial estimates of seeds per gram: 573

Percent seed: n.m.

Percent live: 69

Collection dates: September 25 and October 21.

Collection effort: 433 grams in 12 person hours.

Collection notes: A lot of fluff comes with the seed, so collecting large amounts is time consuming.

Cleaning notes: Bulk seed measurement is with stems, leaves, lemmas, glumes, etc included.

***Solidago missouriensis* – prairie goldenrod**

Average number of good seeds per gram bulk matter: 1278

Average number of good seeds per gram cleaned: 7762

Commercial estimates of seeds per gram: n.m.

Percent seed: n.m.

Percent live: n.m.

Collection dates: November 8 and 12

Collection effort: 31 grams in 2 person hours

Collection notes: Easy to collect large amounts.

Cleaning notes: Bulk measurement is as it comes off of the plant often with involucre and bracts. Clean seed was full (not flat) seeds with fluff.

***Solidago nemoralis* – gray goldenrod**

Average number of good seeds per gram bulk matter: 460

Average number of good seeds per gram cleaned: 3472

Commercial estimates of seeds per gram: n.a.

Percent seed: n.m.

Percent live: n.m.

Collection dates: October 7 and 20; November 8.

Collection effort: 30 grams in 2 person hours

Collection notes: Easy to collect large amounts.

Cleaning notes: Bulk measurement is as it comes off of the plant often with involucre and bracts. Clean seed was full (not flat) seeds with fluff.

***Sporobolus cryptandrus* – sand dropseed**

Average number of good seeds per gram bulk matter: 4040

Average number of good seeds per gram cleaned: n.m.

Commercial estimates of seeds per gram: 3876

Percent seed: 90.6

Percent live: 84

Collection dates: September 2 and 7

Collection effort: 12 grams in 4 person hours

Collection notes: Large numbers of seeds can be collected in a short amount of time from one plant, but seed producing plants aren't common (at least not in 2004). The seed drops within a couple of days after maturing so timing is critical for successful collection.

Cleaning notes: As picked with empty seeds and a few rachises.

***Symphoricarpos occidentalis* – western snowberry**

Average number of good seeds per gram bulk matter: n.m.

Average number of good seeds per gram cleaned: 101

Commercial estimates of seeds per gram: n.a.

Percent seed: n.m.

Percent live: 47

Collection dates: September 23

Collection effort: 48 grams in 6 person hours

Collection notes: Relatively easy to collect. Not all stands produce fruit.

Cleaning notes: To clean seed, wet fruits were mashed and part of pulp removed through floatation or pressing through a sieve. Seeds were dried then a little more pulp removed. There was a lot of pulp remaining in the “cleaned” seed.

***Symphotrichum ericoides* – heath aster**

Average number of good seeds per gram bulk matter: 559

Average number of good seeds per gram cleaned: 3324

Commercial estimates of seeds per gram: n.a.

Percent seed: n.m.

Percent live: 69

Collection dates: November 8 and 22.

Collection effort: 40 grams in 3 person hours

Collection notes: Relatively easy to collect fair amounts once plants are found.

Cleaning notes: Bulk seed measurement was as it comes off of the plant, often with bracts and involucres. Clean seed was hard seed with fluff.

***Verbena bracteata* – prostrate vervain**

Average number of good seeds per gram bulk matter: n.m.

Average number of good seeds per gram cleaned: 1803

Commercial estimates of seeds per gram: n.a.

Percent seed: 74

Percent live: 74

Collection dates: August 30 and September 1.

Collection effort: >4 grams in 3 person hours

Collection notes: Easy to collect in large amounts.

Cleaning notes: Clean seed measurement was obtained using pure seed.

***Verbena stricta* – hoary vervain**

Average number of good seeds per gram bulk matter: n.m.

Average number of good seeds per gram cleaned: 1036

Commercial estimates of seeds per gram: 1096

Percent seed: n.m.

Percent live: n.m.

Collection dates: September 27 and October 11.

Collection effort: >10.4 grams in 2 person hours

Collection notes: Easy to collect in large amounts.

Cleaning notes: Clean seed measurement was for pure seed.



Species: **Amaranthus blitoides** (*Amaranthus graecizans*)

Common name: prostrate pigweed

Seedling Identification: Bright green spatulate leaves are hairless but glandular and thickened. Leaves are very crowded on a short stem.



Species: **Convolvulus arvensis**

Common name: field bindweed

Seedling Identification: Cotyledons are dull green, fairly long and narrow. First true leaves are hastate often with a reddish caste at the base of the leaf.



Species: **Chenopodium spp.**

Common name: common lambsquarters, arid land goosefoot

Seedling Identification: Cotyledons and first true leaves sparkle with a coating that looks like tiny water droplets. Stems are purple and often leaves also are tinged with purple. *C. album* and *C. desiccatum* were both found in the study plots, and the seedlings look very similar. The picture at right is probably *C. desiccatum*, because it was more commonly found.



Species: **Cynoglossum officinale**

Common name: houndstongue

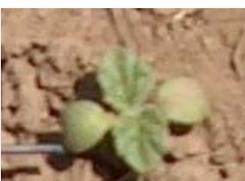
Seedling Identification: Cotyledons are large and very rounded. The first true leaves are softly pubescent, gray green and rolled at emergence.



Species: **Leonurus cardiaca**

Common name: motherwort

Seedling Identification: First true leaves are ovate with later leaves being very lobed (almost maple shaped). The leaves all have extremely irregular venation, and barb-like hairs on the upper and lower surfaces. The hairs tend to be more concentrated on the prominent mid veins on the backs of leaves.



Species: **Marrubium vulgare**

Common name: white horehound

Seedling Identification: Cotyledons are rounded and pubescent. True leaves wrinkled, distinctly veined and covered with whitish pubescence.



Species: ***Trifolium repens***

Common name: white clover

Seedling Identification: Stems red and leaves dull green. First true leaves are rounded and come singly.



Species: ***Onopordum acanthium***

Common name: Scotch thistle

Seedling Identification: Beware of confusing this one (in the seedling stage) with the native thistle *Cirsium undulatum*. There is no reliable way to differentiate between the species until the plants get some size and age.



Species: ***Sisymbrium altissimum***

Common name: tumble mustard, Jim Hill mustard

Seedling Identification: Rosette with lobed leaves, that is very typical looking for the mustard family.



Species: ***Verbascum thapsus***

Common name: common mullein

Seedling Identification: Rounded oval cotyledons. The first primary leaves are more ovate yet still rounded with soft venation and fine pubescence.



Species: ***Anemone cylindrica***
Common name: Candle anemone
Seedling identification: Lobed trifoliate leaves with long soft hairs. Similar to *Potentilla pensylvanica*, but has narrower leaves that are more triangular.



Species: ***Achillea millefolium***
Common name: common yarrow
Seedling Identification: Seedlings are tiny with dissected leaves. Leaves are very pungent with a sage-like smell, so beware of confusing this with *Artemisia frigida*. *Achillea millefolium* has leaves that are much more dissected.



Species: ***Ambrosia psilostachya***
Common name: western ragweed
Seedling identification: First leaves are tri-lobed and coarsely pubescent. Sharp outward pointing hairs line the leaf margin.



Species: ***Artemisia frigida***
Common name: fringed sagewort, prairie sagewort
Seedling Identification: First leaves are tri-lobed, gray green with pubescence. Leaves crushed smell like sage. Just emerged seedlings are easy to confuse with *Achillea millefolium*.



Species: ***Artemisia ludoviciana***

Common name: white sage, man sage

Seedling Identification: Cotyledons are small and rounded. First true leaves are round with slight pubescence.



Species: ***Aesclepias speciosa***

Common name: showy milkweed

Seedling Identification: Shiny, bright green cotyledons are oblong and rounded. Cotyledons elongate with growth. The first true leaves are very long and narrow, rounded at the tip and stand upright.



Species: ***Amorpha canescens***

Common name: leadplant

Seedling Identification: Small, round dull green cotyledons emerge and are followed by true leaves of the same shape and hue.



Species: ***Brickellia eupatorioides*** (*Kuhnia eupatorioides*)
Common name: false boneset
Seedling Identification: Light green in color, with opposite, ovate, petioled, toothed leaves with a prominent mid-vein and moderate pubescence.



Species: ***Chamaesyce glyptosperma*** (*Euphorbia glyptosperma*)
Common name: ribseed sandmat
Seedling Identification: Red stems with small oval leaves that are dull green on the upper surface and red underneath. Leaves lay fairly flat on the ground.



Species: ***Chamaesyce stictospora*** (*Euphorbia stictospora*)
Common name: slimseed sandmat
Seedling Identification: Minute seedling with 2 deep green cotyledons and leaves that are purple as they emerge. Leaves are covered with coarse hair. Mature leaves are green on the top and purple on the bottom.



Species: ***Dyssodia papposa***
Common name: fetid marigold, dogweed
Common name: Rounded cotyledons with the first true leaves being ragged and three pointed at emergence. The true leaves have orange glands at the base of the lobes and a "fetid" smell hence the common name.



Species: ***Cirsium undulatum***

Common name: wavy leaf thistle

Seedling Identification: These seedlings look very similar Scotch thistle (*Onopordum acanthium*) seedlings. However the first leaves of wavy leaf are less lobed and have very fine spines off the leaf edges.



Species: ***Echinacea angustifolia***

Common name: purple coneflower

Seedling Identification: Cotyledons are bean-like and smooth. The first true leaf emerges alone, is long, narrow, moderately to densely hairy and has an entire margin.



Species: ***Erysimum capitatum*** (*Erysimum asperum*)

Common name: western wallflower

Seedling Identification: Spatulate, petioled, sand paper textured leaves that have hairs that lie pointing to the distal end of the leaves.



Species: ***Euphorbia dentata***
Common name: toothed spurge
Seedling Identification: Lanceolate, irregularly serrate leaves with pubescence on top and bottom, plus some times having red spots. Cotyledons are quite large, round and petioled.



Species: ***Grindelia squarrosa***
Common name: curlycup gumweed
Seedling identification: Very similar to the Solidago genus however *Grindelia* seedlings are much more “toothy” and have glands at the base of the teeth. Leaves are lanceolate to spatulate and rough to the touch.



Species: ***Gutierrezia sarothrae***
Common name: broom snakeweed
Seedling identification: Cotyledons and true leaves are long, narrow and dark green and have a turpentine smell when the foliage is crushed. The seedling can easily be confused with *Salsola iberica*, but the later doesn't have the turpentine smell.



Species: ***Helianthus annuus***
Common name: annual sunflower
Seedling Identification: Fairly large rounded cotyledons with large, pubescent true leaves.



Species: ***Heterotheca villosa*** (*Chrysopsis villosa*)
Common name: hairy false goldenaster
Seedling Identification: Small rounded cotyledons and spatulate leaves that are dull green and have very long coarse hair.



Species: ***Ipomoea leptophylla***
Common name: bush morningglory
Seedling identification: The very distinctive cotyledons are lobed, smooth and large in size. Seed coat is fairly persistent after the plant emerges, often staying attached until the cotyledons unfold.



Species: ***Liatris punctata***
Common name: dotted gayfeather, dotted blazing star
Seedling identification: Small dark cotyledon leaves. The first true leaf that emerges from between the cotyledons is long and narrow, with a pronounced light colored midvein, has sparse hair on the margin and gray hair on the underside.



Species: ***Lithospermum incisum***

Common name: narrow leaf gromwell

Seedling identification: Cotyledons are very round. First true leaves are coarsely hairy, narrow, have a prominent midvein and are dark green in color.



Species: ***Mirabilis linearis***

Common name: narrow leaf four o'clock

Seedling identification: Cotyledons are large and very round. The first true leaves are long and narrow with a long petiole. The mid-vein is conspicuous on the leathery leaves.



Species: ***Monarda fistulosa***

Common names: bee balm, horse mint, wild bergamot

Seedling Identification: Easily confused with another mint, *Salvia reflexa*, this species is gray green in color and *Salvia* is bright green. *Monarda fistulosa* has distinctive triangular shaped, notched, cotyledons that are thickened and leathery. The first true leaves to emerge are rounded at the tips, finely pubescent and prominently veined. Later leaves are very serrate and pointed at the tip.



Species: ***Onosmodium molle***

Common name: false gromwell, soft hair marbleseed

Seedling identification: Leaves have parallel venation and soft long hair, are quite large, ovate and rounded at the tip.



Species: ***Opuntia macrorhiza***

Common name: plains prickly pear

Seedling identification: Cotyledons are succulent in appearance, and brownish in color. Spines are obvious once the stem starts to emerge.



Species: ***Penstemon grandiflorus***

Common name: shell leaf penstemon, large beardtongue

Seedling identification: Cotyledons are tiny, narrow, pointed and waxy looking. Initially, when the true leaves emerge one is longer than the other, and the leaves are fairly narrow. As the leaves grow they widen at the center.



Species: ***Plantago patagonica***

Common name: wooly plantain, wooly indianwheat

Seedling identification: Long narrow, wooly, strap-like leaves come from a rosette.

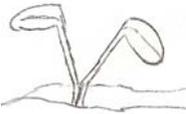




Species: ***Potentilla pensylvanica***
Common name: Pennsylvania cinquefoil
Seedling Identification: First true leaves are tri-lobed, almost thickened and have very soft, fine hair.



Species: ***Psoraleum tenuiflorum***
Common name: slimflower scurfpea
Seedling identification: Cotyledons are shaped like a golf club with petioles almost on the side of the leaf rather than in the center. All leaves are bright, green, shiny and smooth.



Psoraleum seedling



Species: ***Ratibida columnifera***

Common name: prairie coneflower, Mexican hat

Seedling identification: Cotyledons are small and rounded.

When the first true leaf emerges it stands fairly upright from the center of the cotyledons. It's green on the top and gray on the bottom and finely pubescent. Later leaves are irregularly lobed.



Species: ***Rosa arkansana***

Common name: prairie wild rose

Seedling identification: Cotyledons are ovate with a rounded tip, yellowing before dropping. First true leaves are trifoliate, rounded, toothed and dull green.





Species: ***Salvia reflexa***

Common name: lance leaved sage

Seedling identification: Emergent seedlings are easy to confuse with *Monarda fistulosa*, but are greener in color and not leathery. Cotyledons are broadly triangular but rounded at the corners and often notched. First true leaves are long, narrow, and have rounded tips. Veins are prominent.



Species: ***Solanum rostratum***

Common name: buffalobur

Seedling identification: Cotyledons are very rounded and have a purple ring on the margins. First true leaves are lobed and have conspicuous veins, becoming more so as they mature. Mature plants are armed with spines on the stems.



Species: ***Solanum triflorum***

Common name: cutleaf nightshade

Seedling identification: Cotyledons are oblong rounded and dull green. True leaves emerge brighter green in color and a deeply lobed. Leaves may or may not have pubescence.



Species: ***Sphaeralcea coccinea***
Common name: scarlet globemallow
Seedling Identification: Small rounded, lobed leaves are covered with white star shaped hairs.



Species: ***Symphoricarpos occidentalis***
Common name: common snowberry
Seedling identification: Seedlings look much like the adult plants as far as leaf color and shape, but stem is not woody.



Species: ***Symphyotrichum ericoides*** (*Aster ericoides*)
Common name: white heath aster
Seedling identification: Cotyledons are rounded and often have a purple tint. Primary leaves are ovate, hairy (with longer hairs on the margins) and dark green in color.



Species: ***Verbena bracteata***
Common name: prostrate vervain
Seedling identification: Cotyledons are fairly small, ovate and purple tinged. Primary leaves are lobed with prominent veins and are purple tinged near the stem.



Species: ***Verbena stricta***

Common name: hoary vervain

Seedling identification: Cotyledons are purplish, very small and narrow with rounded tips. First leaves are purplish, heavily veined and pubescent.



Pascopyrum smithii

Identifying Grass Seedlings

Planting grass seed in pots and watching it as it grew helped the Wind Cave Seed Study team as much as anything in identifying the grasses in their seedling form. Most species have certain vegetative characteristics that allow them to be identified prior to flowering. The grass seedlings also display those characteristics fairly quickly after germination, but the problem is being able to see them with only the aid of a hand lens and without disturbing or injuring the seedlings. Sadly enough the project doesn't have a camera with microscopic capabilities that would be necessary to display these traits in pictures, so drawings and written descriptions will have to suffice.



Sporobolus cryptandrus

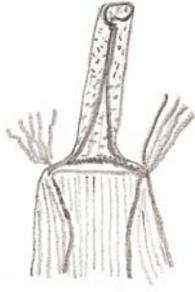


Species: ***Andropogon gerardii***

Common name: big bluestem

Vegetative identification: Young shoots are reddish brown with sheaths that are very pubescent and flattened. Leaf blades have long hairs on the margins and upper surface of the blade.

Andropogon gerardii

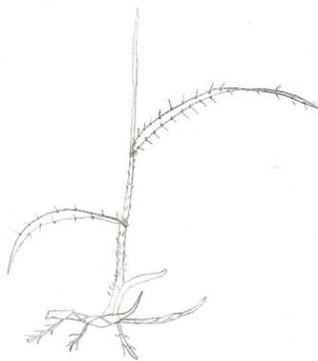


Aristida purpurea

Species: ***Aristida purpurea***

Common name: red three awn

Vegetative identification: Tufts of long hair protrude from each side of the sheath at the collar. The sheath is split partway down then overlapping. Sheath also has prominent veins and translucent margins. New leaves are rolled in the bud. Leaf blades are narrow and bristle like, often curled and twisted. Leaf surface and margins are rough to the touch.

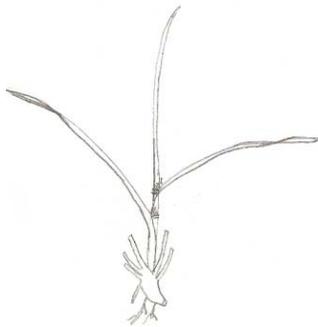


Bouteloua curtipendula

Species: ***Bouteloua curtipendula***

Common name: sideoats grama

Vegetative identification: Glandular hairs regularly positioned on the margin of the leaf blade. New growth is frequently reddish in color near the base of the plant. Leaf blades are generally flat and drooping.

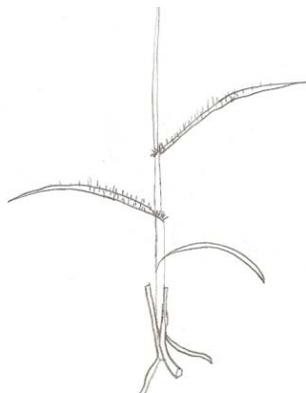


Bouteloua gracilis

Species: ***Bouteloua gracilis***

Common name: blue grama

Vegetative identification: Blades narrow, drooping and usually smooth except at the collar where there is a tuft of hair sticking out from each side of the collar.



Bouteloua hirsuta

Species: ***Bouteloua hirsuta***

Common name: hairy grama

Vegetative identification: Blade and collar have conspicuous glandular hairs, mostly on the upper surface but occasionally on the lower also. The collar has a larger tuft of hair on each side. The sheath is smooth and papery. The leaves are flat, short and drooping.

This species can be difficult to tell from blue grama or buffalograss while vegetative.



Dichantherium oligosanthes

Species: ***Dichantherium oligosanthes***

Common name: Scribner's dichantherium

Vegetative identification: Cotyledon leaves are very wide and pointed. Even at emergence, they have a tufted appearance. The sheath has long soft spreading hairs and on some plants the blades also have hair. Prior to the emergence of the sheath, this species could be confused with *Sporobolus cryptandrus*, but the leaves of *Dichantherium* are quite a bit wider, the blade tip more acutely pointed and it is a darker green.



Elymus elymoides

Species: ***Elymus elymoides (Sitanion hystrix)***

Common name: bottlebrush squirreltail

Vegetative identification: Sheath is split part of the way down, has translucent margins, indistinct veins, large claw-like auricles and can be smooth or have very short hairs.

Blades are rolled in the bud, distinctly veined and finely pubescent with a prominent mid-vein on the back.

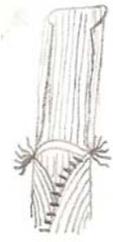


Koeleria macrantha

Species: ***Koeleria macrantha (Koeleria pyramidata, Koeleria cristata)***

Common name: prairie junegrass

Vegetative identification: The leaf is folded in bud. The stiff blades are hairy with short hairs dorsally and ventrally and longer hairs on the margins. Blades are distinctly ribbed dorsally. Blade margins are lightly toothed have a narrow white band. The collar has a hairy margin, is divided and usually is greenish white. Sheath is distinctly veined and light green or occasionally reddish. This conspicuously dark green grass starts growing early in the spring and has a semi-decumbent growth pattern.

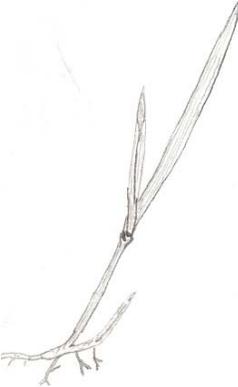


Nasella viridula

Species: ***Nasella viridula*** (*Stipa viridula*)

Common name: green needlegrass

Vegetative identification: There is a tuft of hair at each edge of the collar plus hairs extending down the outer margin of the sheath. Blades are bright almost lime green, with a prominent mid-rib on the back of the blade and prominent veins on top of the leaves. The leaves are very rough on the upper surface and to a lesser extent on the bottom. Blades are rolled at emergence and seedlings often have a twist at the end of the blade.

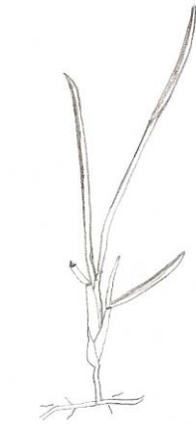


Pascopyrum smithii

Species: ***Pascopyrum smithii*** (*Agropyron smithii*)

Common name: western wheatgrass

Vegetative identification: Emerges green with a very narrow spindly leaf, and gradually turns the distinctive blue-green color. The prominent veins and claw-like auricles are visible fairly early in growth. Seedlings are sometimes purplish or brown at the base and the emerging leaf often forms a corkscrew shape.

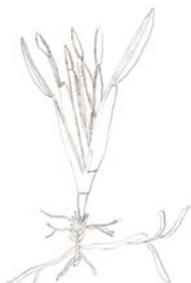


Poa pratensis

Species: ***Poa pratensis***

Common name: Kentucky bluegrass

Vegetative identification: Blades are angled with the stem, boat shaped tips and are folded in the bud. Blades are deep green, have a prominent, wide ventral midrib with two narrower, less conspicuous veins on each side of it. The sheath is compressed but not flat, which at times makes it easy to confuse with little bluestem.



Schedonnardus paniculatus

Species: ***Schedonnardus paniculatus***

Common name: tumblegrass

Vegetative identification: Early on this can look like a sick looking little bluestem. The leaf blades are blue-green with white margins, have a distinct mid-rib on the back with a prominent vein on each side of it. The blades are keeled near the sheath and smooth on both sides. The sheath is flat.



Schizachyrium scoparium

Species: ***Schizachyrium scoparium* (*Andropogon scoparius*)**

Common name: little bluestem

Vegetative identification: Sheaths are very flat and often pinkish at the base. Leaves are folded in the bud and the cross section is sometimes flat but mostly folded or v-shaped. Seedlings are light green, turning reddish brown at maturity.



Sporobolus cryptandrus

Species: ***Sporobolus cryptandrus***

Common name: sand dropseed

Vegetative identification: Growth is decumbent. Leaves are concave, wide, short, smooth and dark green in color. Leaf tips are often inrolled. There is a conspicuous ring of long hairs at the collar, giving the plant the look of wearing an Elizabethan collar.



